Enabling people to apply insights from Earth science drives us in the Applied Sciences Program. We envision a future where uses of Earth science information are common, people widely recognize the benefits, and there’s strong desire for more data and insights.

Earth and space are intrinsically linked. Using the vantage point of space, NASA’s Earth Science Division discovers new insights about the planet and the complex interactions within the Earth system. Within the Division, the Applied Sciences Program works with institutions worldwide to power innovative projects that improve their decisions and actions through the application of Earth science data and information. We draw on our connections with users to bring their feedback, research questions, and desires back to our Division colleagues to further improve NASA’s Earth science research and technology.
In 2020, we reflected on how Applied Sciences has accomplished its work to date and the challenges we still face. Through several strategy sessions, we concluded that our priorities to advance beneficial uses of Earth science involve further refining our engagement with the private sector and nonprofits and more robust scaling of successful applications, while continuing our high-quality applications development and applied research. We can also reach new audiences and spark interest in applications by leveraging engaging stories on the impacts of Earth science to improve our daily lives.

This Strategic Plan reflects our vision and ambitions, and it emphasizes the dual roles we play in the Earth science community – to expand uses of Earth science in society and to bring in fresh and diverse user perspectives.

As NASA continues to advance our understanding of the Earth, we’re excited about the many opportunities to further enable the benefits from Earth science applications. We welcome you on our journey toward advancing Earth science in action.

Best regards,

Lawrence Friedl
Director, Applied Sciences Program

Bradley W
David Green
John Haynes
Nancy Searby
Emily Sylak-Glassman
Woody Turner
“Applied Sciences serves a fundamental role to advance global knowledge about effective ways to extend and apply Earth science and inform decisions and actions.”

- ASAC committee

Graphic is Still in Development
A WORLD WHERE EARTH SCIENCE DATA AND KNOWLEDGE ROUTINELY GUIDE DECISIONS AT ALL LEVELS OF SOCIETY – AND PEOPLE WANT MORE.

MISSION

Apply insights from Earth science to benefit the economy, health, quality of life, and environment across the globe.

VALUE PROPOSITION

Applied Sciences makes financial and programmatic investments to generate creative solutions and lower the technical and institutional barriers to using Earth science information. Our investments magnify the value of the Earth science information that NASA collects and disseminates. From global to local scales, we bridge gaps between scientific findings and practical applications to expedite benefits. We pursue two-way endeavors with organizations along the value chain for effective solutions as well as with our Earth Science Division colleagues to accelerate returns from open data and research. By nurturing networks of researchers and practitioners that apply NASA and other Earth observations, we open more pathways to inform everyday decisions, develop sound policy, and enable business opportunities.
INNOVATION
We experiment, accept risk, embrace agility and flexibility, and continuously refine our approaches technically and programmatically. We promote opportunities and assess emerging needs to inspire novel applications of Earth science information.

INTEGRITY
We stay informed of Earth science advances, pursue the most appropriate science for partners’ uses, and convey accurate information about the Earth science uses we advance, including the capabilities and the limitations of Earth observations for their application.

INCLUSION
We embrace a culture where all views and voices are welcome and included with special attention on supporting underrepresented and disadvantaged communities. We maintain high standards and stop inappropriate behavior, so that everyone can contribute to their fullest potential.

COLLABORATION
We embrace a culture of collaboration among information producers, applications specialists, partners, and users. We listen to understand perspectives, challenges, needs, and desires for improvement. We pursue and leverage partnerships, working together to extend information and services to benefit society.
Many citizens, organizations, and communities benefit from NASA’s investments in Earth science. Greater awareness of the benefits can spur even more applications and benefits. Applied Sciences cultivates engaging stories about our projects and people, celebrating our partners’ achievements, and featuring fresh, diverse voices to reach new audiences. Our stories and our storytelling have a power to showcase impactful uses and enable the uptake of Earth observations that is as important as our technical innovations.

Amplifying societal returns from Earth system science begins from the initial design of scientific pursuits, observing architectures, and spacecraft missions. Applied Sciences actively engages with other parts of NASA Earth Science to support the Division’s goals. As we support the Division’s engagements with the Earth science community, our direct connections with end-user communities provide us with unique opportunities – and a responsibility – to provide input to the Division on novel research questions and beneficial design elements.

We enable the early and ongoing consideration of applications throughout mission lifecycles. We support improved abilities for people to develop applications, contribute to mission planning and design, and be prepared to use data after launch. We encourage feedback on data and information products from unique user perspectives. We facilitate interactions among researchers and users at ever-growing levels of complexity for discussions of novel research pursuits. Collectively, these efforts grow users’ awareness and anticipation of Earth science missions, data, and research as well as their interest in Earth science and the benefits to society.
ACCELERATING RETURNS
Science spans basic research through applications. The rich interactions across the spectrum create inspirations and benefits in both directions. As we promote efforts to amplify the cross-benefits of research and applications within the Earth Science Division and the broader community, we seek to quicken discovery and usage, open up new lines of research and application, and accelerate returns.

TRANSVERSE ACTIVITIES
These items apply to each of our goals and shape our overall program.

ACCELERATING RETURNS
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KNOWLEDGE SHARING
Decades of work with Earth science applications have built knowledge about effective pathways to apply Earth observations to inform choices and guide decisions. Sharing this knowledge is critical to enabling greater benefits. Activities involve compiling collective knowledge, sharing interactive guidebooks, and enabling enriching forums for project teams, proposers, and partners.

RESILIENCE
Earth science presents unique insights into risks from natural and anthropogenic stresses. Our efforts help translate those insights into fostering resilient communities, enabling significant benefits or avoided losses. We work together with public and private sector partners in characterizing vulnerabilities and exposure to risks, providing information to guide actions and sustainable resilience.

GEOSPATIAL SERVICES
Geographic information systems and other geospatial technologies are common tools in user communities to analyze and guide decisions. They represent important opportunities to disseminate NASA’s open data and to enable applications. Building on an internal assessment of geospatial services, our activities with geospatial technologies, products, and services apply across our program and align with the Earth Science Division’s geospatial efforts.
GOALS
Applied Sciences advances the development of products and services that demonstrate practical and innovative applications of Earth science information. We combine direct ways to support applications, such as grants and consortia, with indirect methods to stimulate ideas and innovations, such as prize competitions. With a priority on NASA data, our scope supports applications also integrating non-NASA observations, socioeconomic data, crowdsourcing, and other information. Our work includes involving users and their perspectives in research- and mission formulation activities. Through investments and partnerships, we strive to overcome barriers that hinder the use of Earth observations, accelerate the time to achieve benefits, and magnify the impacts of the applications.

By 2025, Applied Sciences will:

- Pursue efforts to apply and integrate Earth observations throughout the value chains of communities.
- Expand engagement of user communities with NASA Earth Science teams and enhance applications throughout mission lifecycles.
- Integrate Earth observations into trusted portals and tools across communities, amplifying the reach of Earth science.
- Re-examine solicitation mechanisms to identify highly effective approaches and pursue new funding models, supporting co-production and accelerating uptake of applications.
- Optimize the replication of successful applications, especially domestically, and pursue opportunities to appropriately scale them.
- Advance methods for successful transition of applications and sustained impact.
Applied Sciences works with individuals and organizations, domestically and internationally, to expand their knowledge and abilities to use Earth observations effectively. This knowledge-sharing work spans a range of skills that allow people and project teams to achieve successful, sustainable applications. Beyond ways to use Earth system science, it involves developing abilities for activities like managing multidisciplinary teams, accessing NASA’s data and research, engaging communities, and expanding communications skills. It involves activities that empower upcoming generations and concerted efforts to enhance diversity and increase inclusion, including sustained engagement with historically under-represented and disadvantaged groups. This knowledge sharing and skill building enable richer applications, more productive user communities, and greater Earth science impacts.

By 2025, Applied Sciences will:

- Introduce new skill-building approaches and partnerships to dramatically expand domestic and international audiences for using Earth system science, building on existing training capabilities.
- Develop the capacities of, and avenues for, scientists, project teams, partners, and users to craft engaging stories about how NASA, and other, Earth observations and related information benefit people and society.
- Expand knowledge on methods to quantify social, environmental, and economic impacts of Earth science, increasing refereed publications, use cases, and interdisciplinary pursuits.
- Broadcast information about Earth science-related career paths, helping students, young professionals, and especially under-represented groups identify opportunities.
- Strengthen incentives with academia and scientific institutions to pursue applications, develop associated skills, and reward connections between research and applications.
Applied Sciences is expanding its connections businesses, foundations, and nonprofit organizations, while continuing to build upon our robust partnerships with government agencies. Embedding Earth science data in the products and services that these groups provide can further economic development; conservation and humanitarian efforts; resilient communities; supply chains; sustainability; and advances in health. To do all this, Applied Sciences must learn and adopt new practices around the acceleration of applications, commercialization, and business innovation. Through this work, we can expand our reach to new audiences, dramatically increase the demand for Earth science knowledge, and create opportunities for the Earth science community.

By 2025, Applied Sciences will:

- Pursue opportunities across sectors that can benefit from the use of Earth observations, implementing targeted partnerships with businesses, foundations, and nonprofit organizations.
- Work to embed Earth science information in the products and services that private companies, nonprofit organizations, government agencies, and others provide to their clients as well as in their own tools and internal decision-making.
- Formulate partnerships with incubators, accelerators, and other entities aligned to support our engagement aims.
- Advance Division-wide discussions with industries to understand value chains, pain points, data interests, and scientific questions, helping translate this information into initiatives, research agendas, and application development opportunities.
**USER-CENTERED**

We plan to expand our methods for collaborating with partners, integrating users more into applications design and development. An increased use of design-thinking, needs-oriented, and co-production approaches complements our traditional engineering-based method. The broader range of methods improves our flexibility as we listen to, empathize with, and understand users’ perspectives and conditions. Greater emphasis on user-centered ways helps our project teams and partners be more successful in designing and developing sustainable, impactful solutions.

**MARKET-ORIENTED**

We plan to conduct market research studies across our program areas to support our planning and priority-setting. Information in market research studies about sector characteristics, preferences, and perceptions helps us target key populations to serve, identify trusted associations and portals, prioritize solicitation methods and topics, and design engagement and outreach activities. Market-oriented approaches incorporating user information enriches our work in existing areas and the pursuit of new ones.

**COMMUNITY LEADING**

Our personnel and project teams actively participate in and lead committees and working groups nationally and internationally. We engage with sector-specific associations, industry groups, and Earth science societies to leverage resources and pursue collective goals. We collaborate through the Group on Earth Observations, the United States Group on Earth Observations, the Committee on Earth Observation Satellites, and other organizations to widen our reach and impact. We plan to build on these efforts and expand our connections, using our positions to also emphasize inclusion and diversity.

**IMPACT-FOCUSED**

We place a high priority on substantial and lasting impacts - both our own and our communities. We continually assess our methods and outcomes, consider alternative approaches and remain agile. For our project portfolio, we plan to evaluate our Applications Readiness Level metric, making adjustments for more user-centered approaches and expanding use as a diagnostic tool. Together with traditional solicitations, we plan to examine acquisition approaches that favor flexibility and provide incentives for performance. We will be vigilant in writing our solicitations and reviewing proposals to reduce biases and ensure diverse review panels to support evermore impactful projects.
SUCCESS

Applied Sciences performance and success are predicated on sharing information and communicating impacts with our community, partners and the public as well as within NASA.

Whether a particular application succeeds or fails, we must share the results. When applications succeed, we must share the information to encourage others to adopt it. We must recognize and celebrate the achievement. When applications fail, we must share the information, so that others may learn from our mistakes and approach the same problem in a new way. We must also consider opportunities for scaling appropriate activities to achieve greater returns on our investments. These elements in our approach extend our reach and spur the demand for additional research and data.

Our success with this Strategy means:

- Applications using Earth System knowledge are in high demand domestically and internationally and are prominent within NASA, the Earth science community and beyond.
- A vibrant and growing community exists with the skills to use, assess value, and communicate the importance of Earth science information on a societal and personal level.
- High-quality applications that incorporate Earth observations spark innovations in the economy, environmental sustainability, and public services.

Success means the Applied Sciences Program is recognized as a value oriented program, an applications leader, a trusted and sought-after partner, and an effective champion of Earth science that amplifies NASA’s mission and benefits society.
DEFINITIONS & DOCUMENTS

Applications Readiness Level
Applications Readiness Level (ARL) is a nine-step index to track and assess progression and maturity of projects. ARLs were adapted from NASA Technology Readiness Levels that manage development and risk. Generally ARLs 1-3 encompass discovery and feasibility; ARLs 4-6 address development, testing, and validation; and ARLs 7-9 focus on integration of the “application” into an end-user’s decision-making activity. ARLs begin at the proposal phase.

Design Thinking
A design methodology that provides a solution-based approach to solving problems. There are five stages of Design Thinking: Empathize, Define (the problem), Ideate, Prototype, and Test.

Co-Production
Co-production of knowledge is the contribution of multiple knowledge sources and capacities from different communities spanning the science–policy–society interface. It also refers to the collaborative development of new applications that is done together with partners, users and Principle Investigators. Ideas are shared and improved with all participants working together in all phases of the project.

Communities
Communities refer to geographic community such as city or region or a network of individuals and organizations that have a common collective interest i.e. the water resources community. Community also refers to the Interagency and Intergovernmental Committees; Professional societies; nonprofit organizations, and Industry Associations with a focus on Earth science and remote sensing. The term encompass those entities that address technical and policy coordination; integration of Earth science knowledge into an industry sector and can raise awareness for the importance of Earth science knowledge.

Geographic Information Systems
Geographic Information System (GIS) have many components: visualizations through interactive maps, data based on the location attribution, spatial analytic functions, and applications which enable user-friendly interfaces. GIS is focused on high-value Earth science data products that are interactive, interoperable, and compliant with GIS platforms; and provide the maximum impact.

Geospatial Services
Geospatial services include the engineering, processing, web service publication, application and development, strategy, and governance of data.

Market Research
Market studies produce information on user needs, preferences, attitudes, behaviors, and perceptions toward products, services, information delivery, etc. Applied Sciences employs market research studies to characterize users, determine priority topics and identify effective engagement strategies and targeted outreach activities.

Partner
An individual or organization that Applied Sciences works with.

Resilience
The ability of a system, community or society to resist, absorb, adapt, and recover from stresses, shocks and threats in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

User
An individual or organization that utilizes the data, information, technology.

Value Chain
The value chain for the Earth Observations Enterprise includes the researchers and scientists; providers of observations and observation system infrastructure; brokers of the data, information and technologies; intermediaries who use earth information to create end-user solutions; end-users who benefit through better scientific understanding, improved safety, or economic efficiency gains. A community or sector can also have its own defined value chain.

KEY DOCUMENTS:

NASA Strategic Plan 2018
ESD Science Strategy
Earth Decadal Science 2030 Agenda for Sustainable Development
2019 National Plan for Civil Observations
Sendai Framework for Disaster Risk Reduction (2015–2030)
Other TBD